



DARK ENERGY
SURVEY

PreCam Update: Simulations

Douglas Tucker, DES-Calib Telecon, 28 Jan 2008

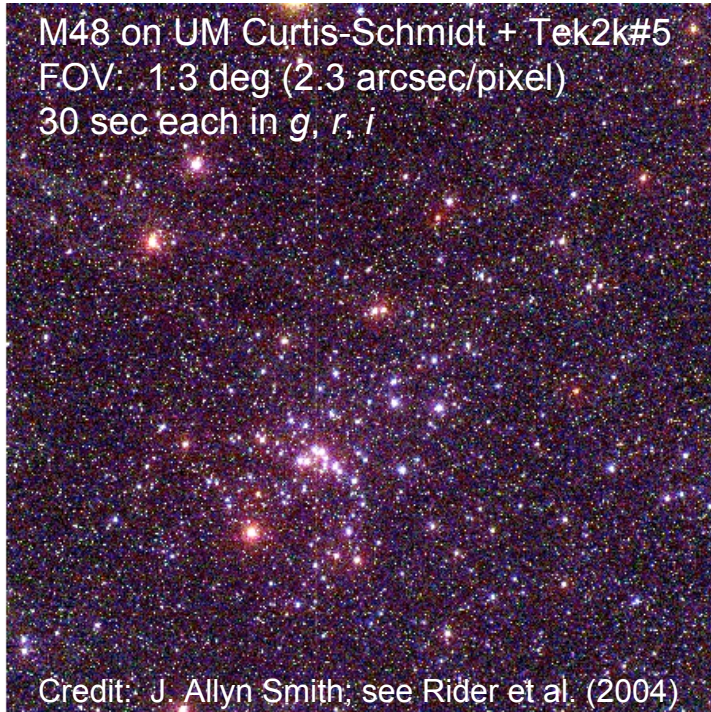




PreCam: Description

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- Baseline instrument:
2x2 mosaic of DECam 2k x 2k CCDs
- Possible upgrades:
 - 2x3 mosaic
 - DECam 2k x 4k CCDs
 - If yield is high enough
- For baseline instrument:
 - FOV of $1.6^\circ \times 1.6^\circ$ (2.69 sq deg) for baseline instrument at a pixel scale of 1.4 arcsec/pixel
 - 1860 fields to cover 5000 sq deg
 - At 600 sec per field (see Table), it would take 372 hours, or about 47 nights, to perform a single-pass PreCam Survey in all 5 DES filters



Baseline PreCam Survey Magnitude Limits

Band	Exposure time [seconds]	S/N=50 in 6" beam [mag]
g	60	18.7
r	90	18.3
i	120	18.0
z	150	17.3
Y	180	15.9



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PreCam: Benefits to DES (I)

(see DES-doc-2373 for more)

The baseline PreCam Survey -- a single-pass survey of the full DES footprint in all 5 DES filters down to $i \approx 18$ -- would yield a catalog of several million bright stars calibrated in the DES *grizY* photometric system (typically hundreds per DECam CCD).

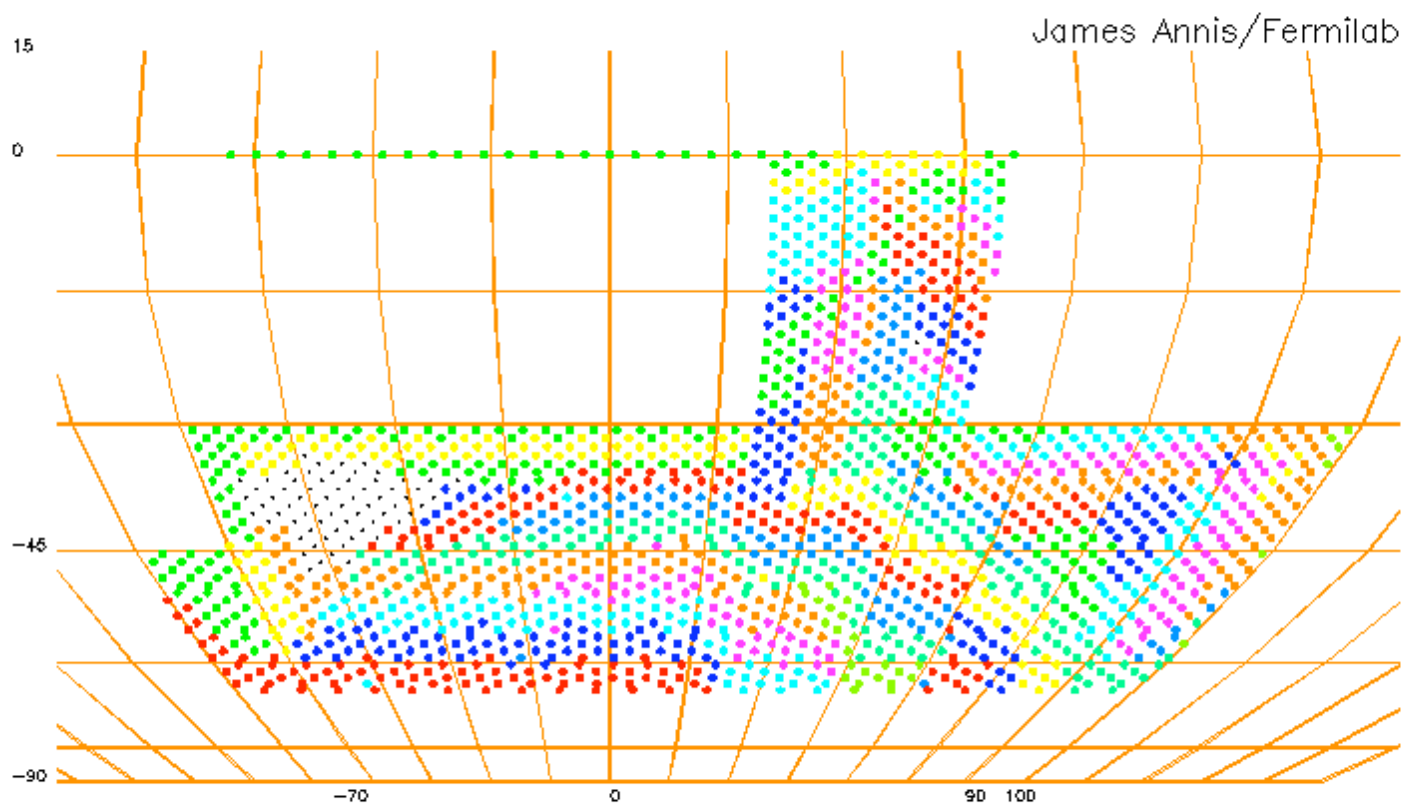
1. If the PreCam Survey can achieve:
 - a. 5% global relative calibrations (*easy*), the PreCam star catalog would be useful for “quick look” diagnostics of the DECam data.
 - b. 2% global relative calibrations (*do-able*), the PreCam star catalog could:
 - i. Start to be used as extinction standards, supplementing the SDSS Stripe 82 standards and the Smith et al. Southern $u'g'r'i'z'$ standards (could reduce the amount of time needed for observing standard stars during twilight and/or during middle of night)
 - ii. Be used for a robust determination of the transformation relations between the SDSS and DES photometric systems
 - iii. Be used as initial Y-band standards (see 1b(i))
 - c. <1% global relative calibrations (*very challenging*), the PreCam star catalog could be used as local standards over the entire DES footprint, obviating the need for observing standard stars during twilight or during the middle of the night
 - i. All DES twilight observations could be reserved for z- and Y-band science observations
 - ii. This would effectively increase the amount of time for science observations by 1 hour per night, thus increasing DES observing efficiency by about 10%.



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DES Survey Strategy Simulations by Jim Annis

DES Simulation T1/A: tileMap-2012.gif

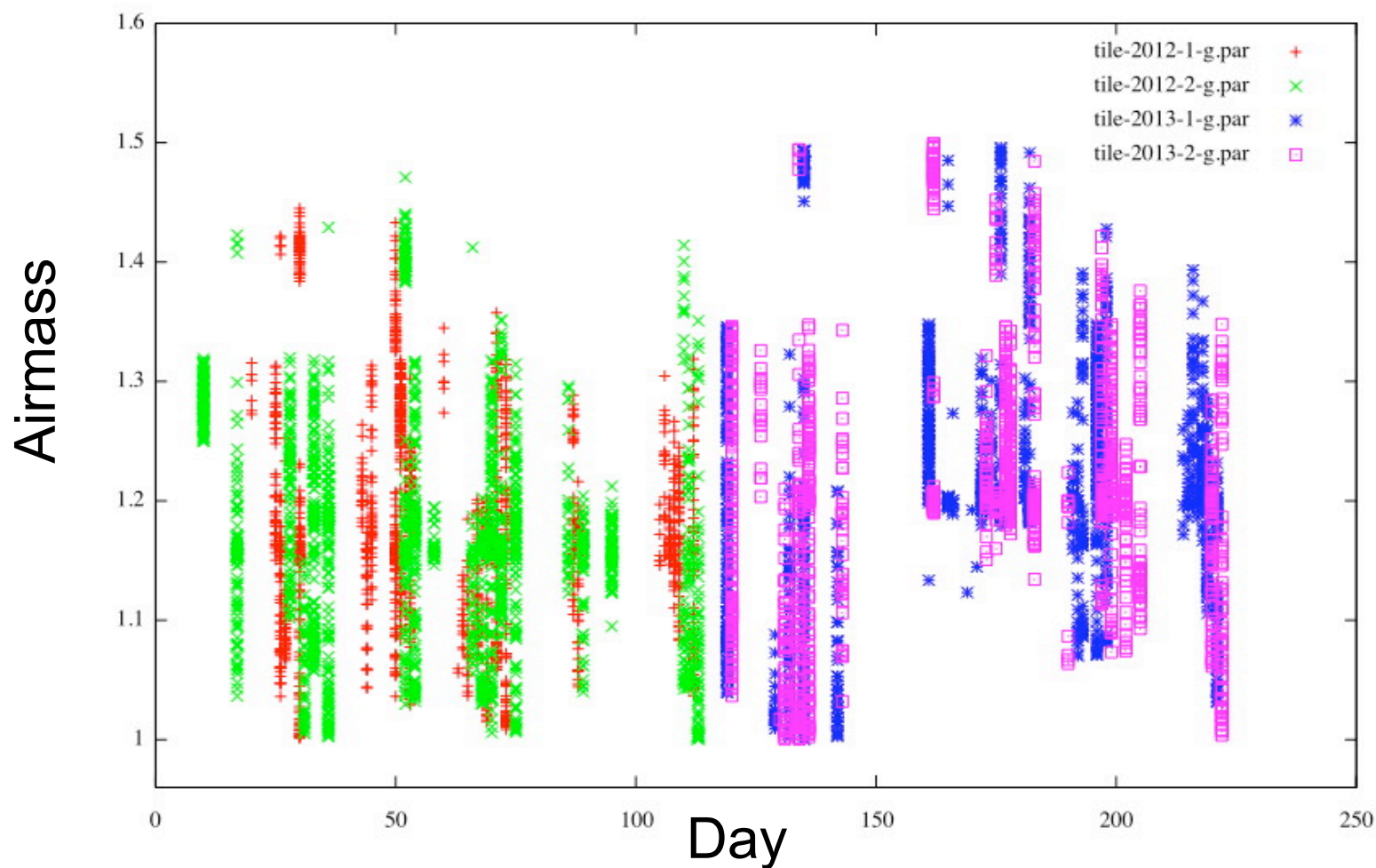




DES Survey Strategy Simulations by Jim Annis

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Simulation T1/A: g-band





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PreCam Extinction Study Simulations: Toy Model

- Assume each PreCam field has a systematic calibration error
 - The accepted magnitudes of all stars in a given PreCam field are all offset by some amount
 - Assume that this calibration error is random and Gaussian, with $\sigma = \dots$
 - 0.05mag (easy)
 - 0.02mag (do-able)
 - 0.01mag (challenging)
- Use the PreCam fields to fit a photometric equation of the form:
$$m_{inst} - m_{accepted} = a + k * X$$

where a = photometric zerpoint, k =first order extinction, X =airmass
- Fit the above photometric equation during a DES night using all airmasses X from for DES science exposures for that night as tabulated in Jim's simulations.
- Calculate and plot residuals

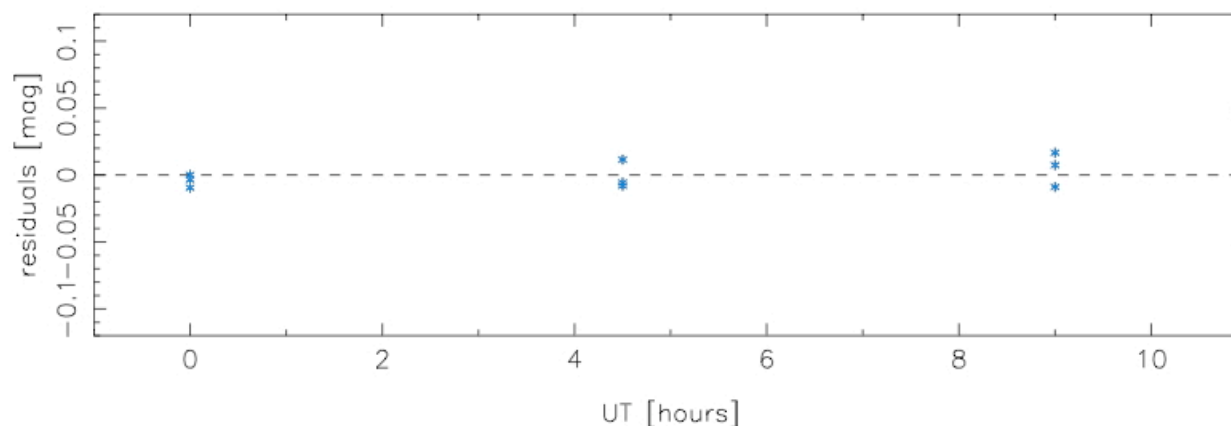
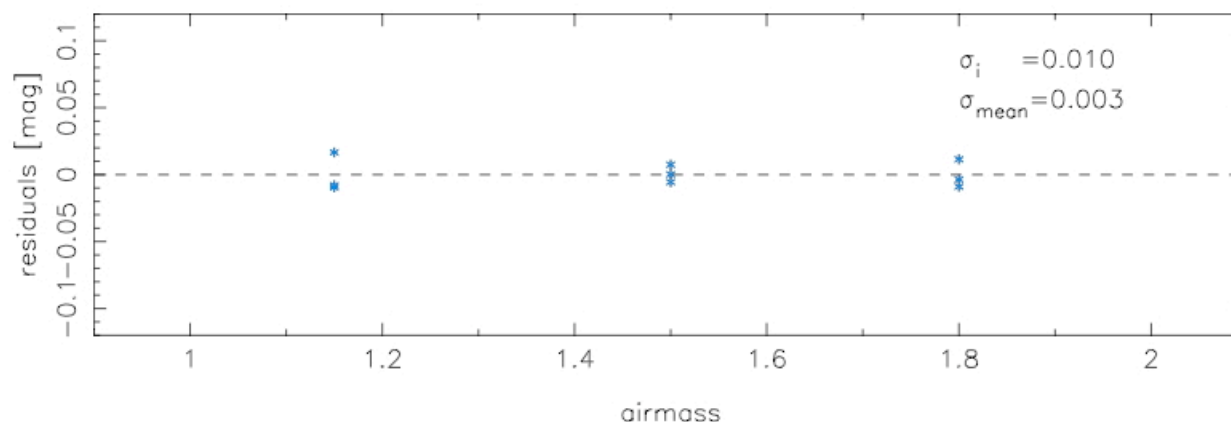


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PreCam Extinction Study Simulations: Default (Stripe 82 alone, No PreCam)

(Stripe 82 field-to-field errors $\sim 0.01\text{mag}$)

Photometric Solution: tile-2012-1-g.par, night -1 (MJD56140)



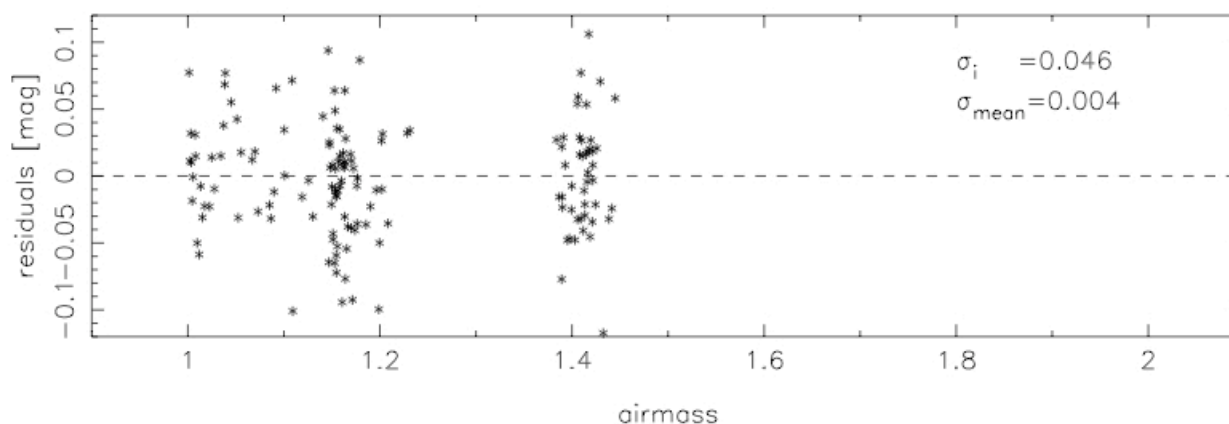
Observe
Stripe 82
fields at 3
different
airmasses at
evening and
morning
twilight and
once in the
middle of the
night



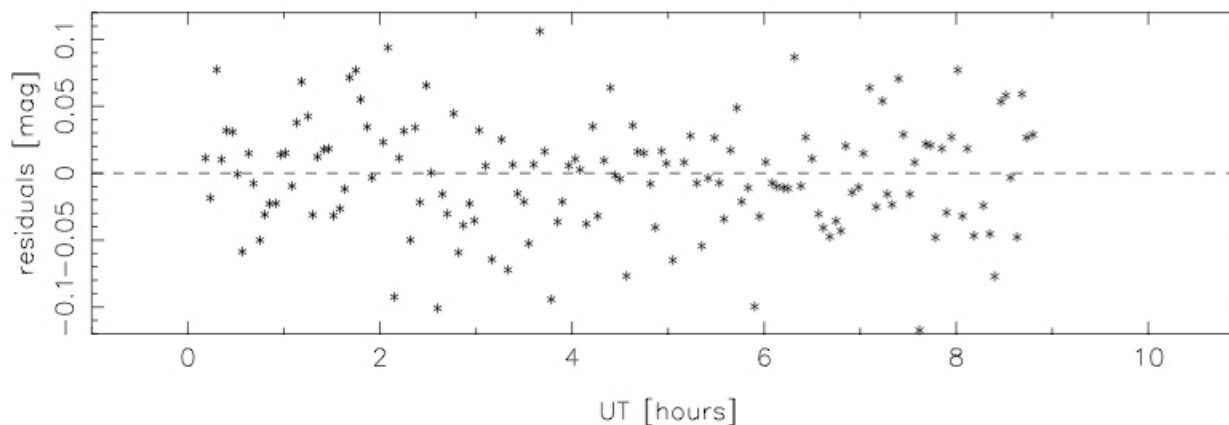
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PreCam Extinction Study Simulations : PreCam (0.05mag Errors)

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)



σ_{mean} still
comparable
due to large
of
observations



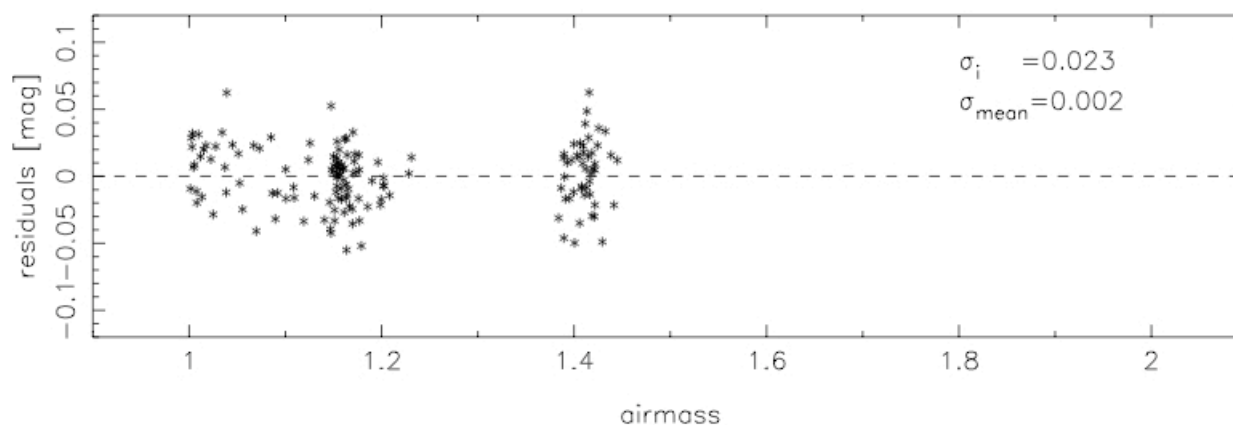
Hard to see
any trends
though



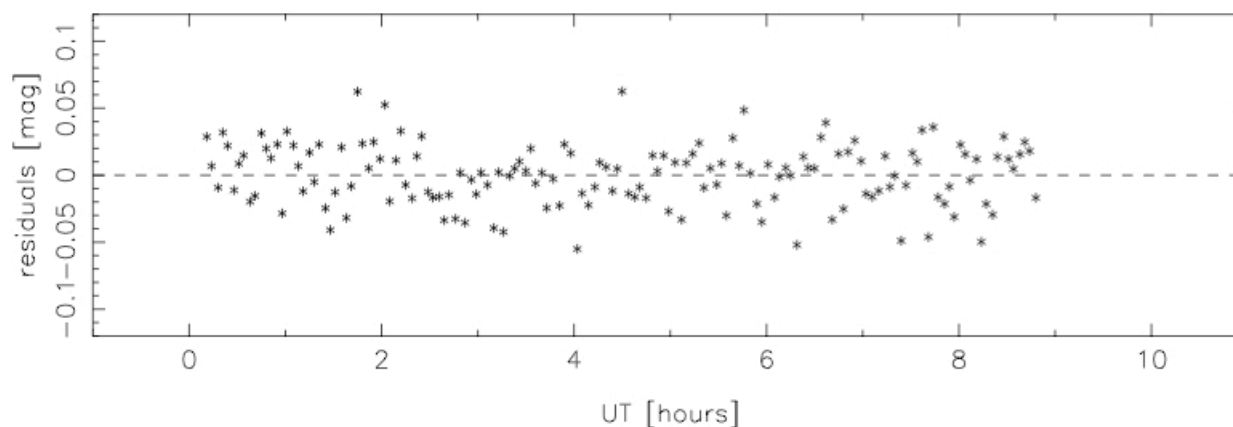
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PreCam Extinction Study Simulations: PreCam (0.02mag Errors)

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)



σ_{mean} gets
better



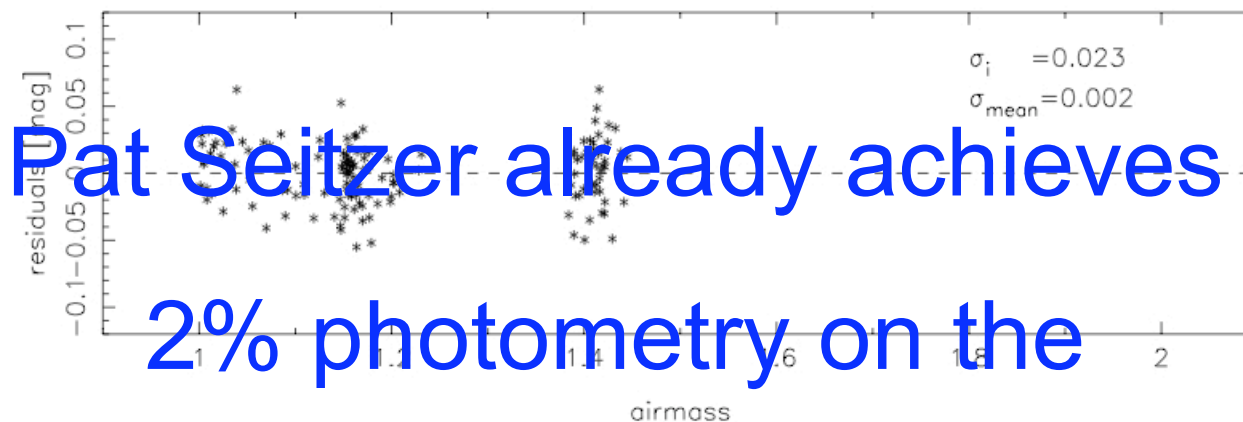
Trends at
0.02 mag
level would
become
noticeable



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PreCam Extinction Study Simulations: PreCam (0.02mag Errors)

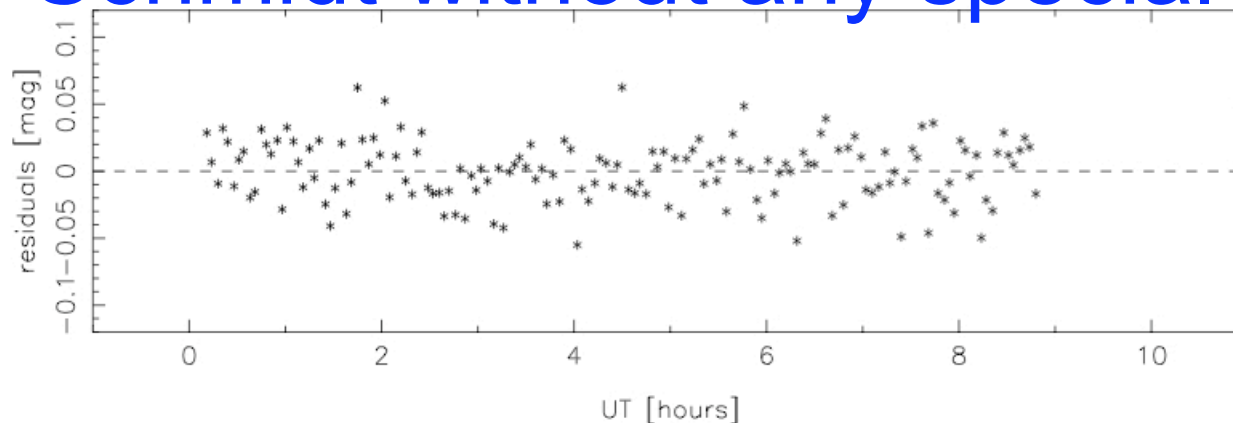
Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)



σ_{mean} gets
better

Pat Seitzer already achieves
2% photometry on the

Curtis-Schmidt without any special effort.



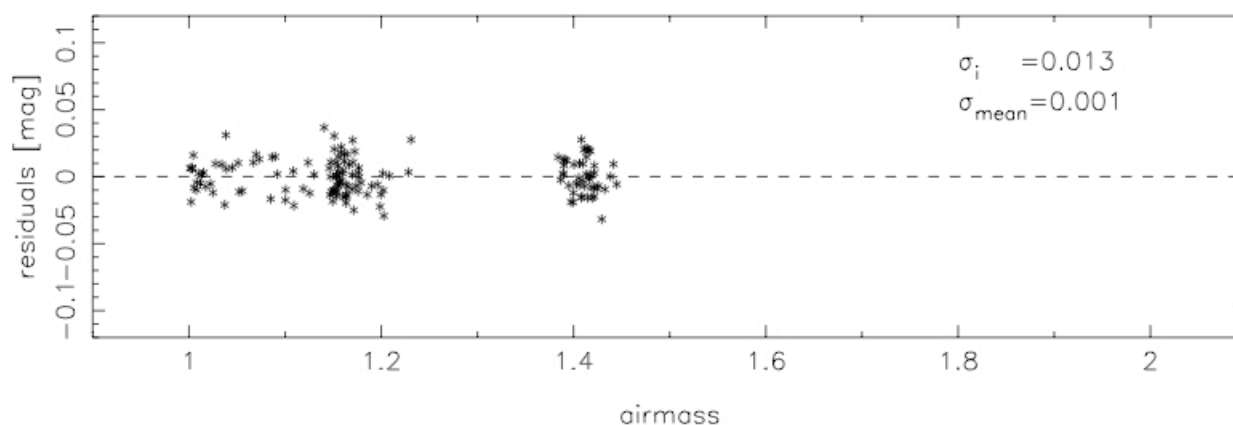
Trends at
0.02 mag
level would
become
noticeable



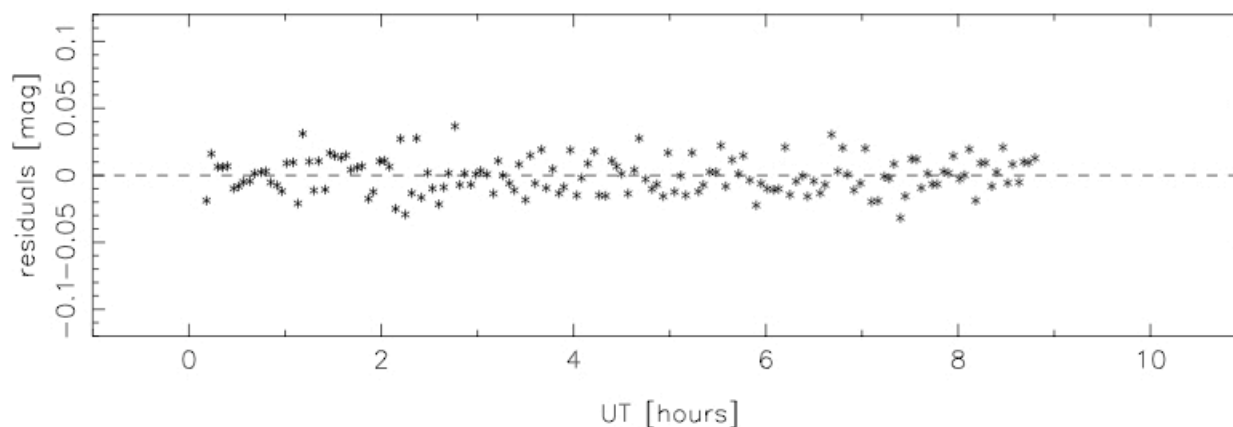
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PreCam Extinction Study Simulations: PreCam (0.01mag Errors)

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)



σ_{mean} gets
even better



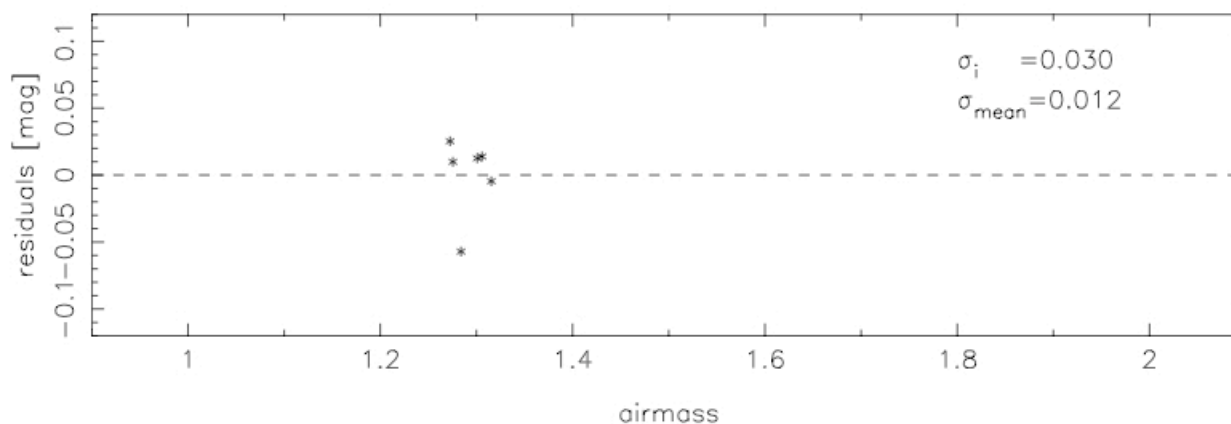
Trends at
0.01 mag
level would
become
noticeable



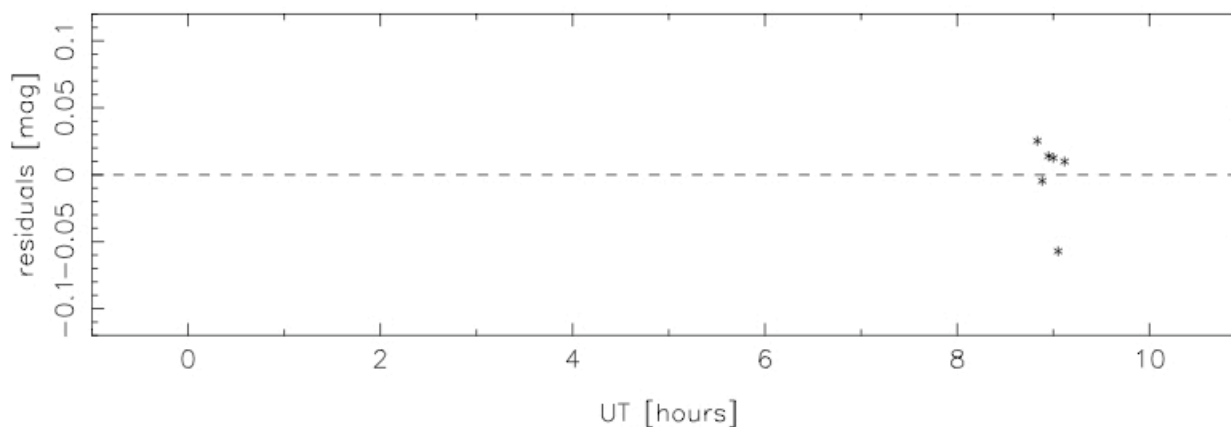
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PreCam Extinction Study Simulations : PreCam (0.02mag Errors)

Photometric Solution: tile-2012-1-g.par, night 20 (MJD56197)



Some nights
have only a
few obs.
in a given
filter, yielding
relatively
poor σ_{mean}

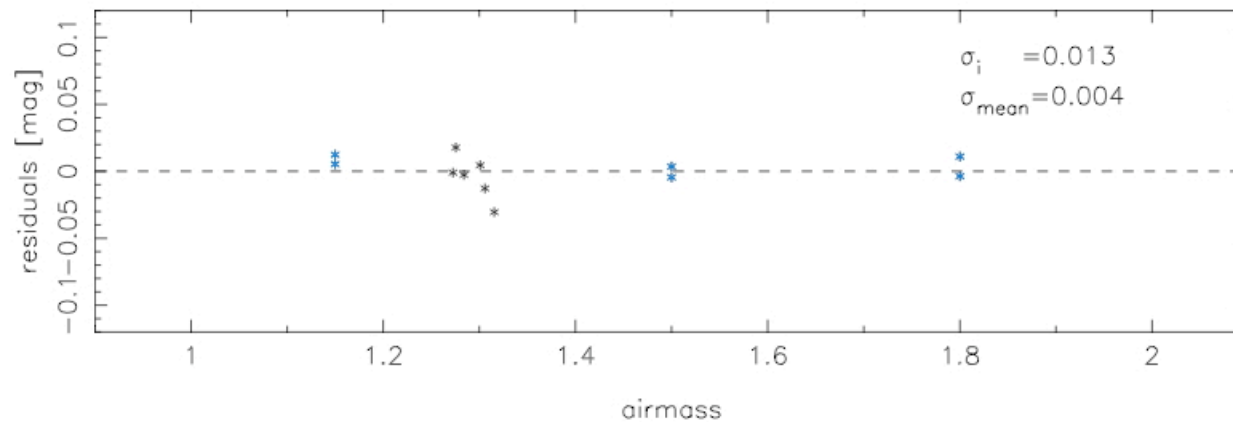




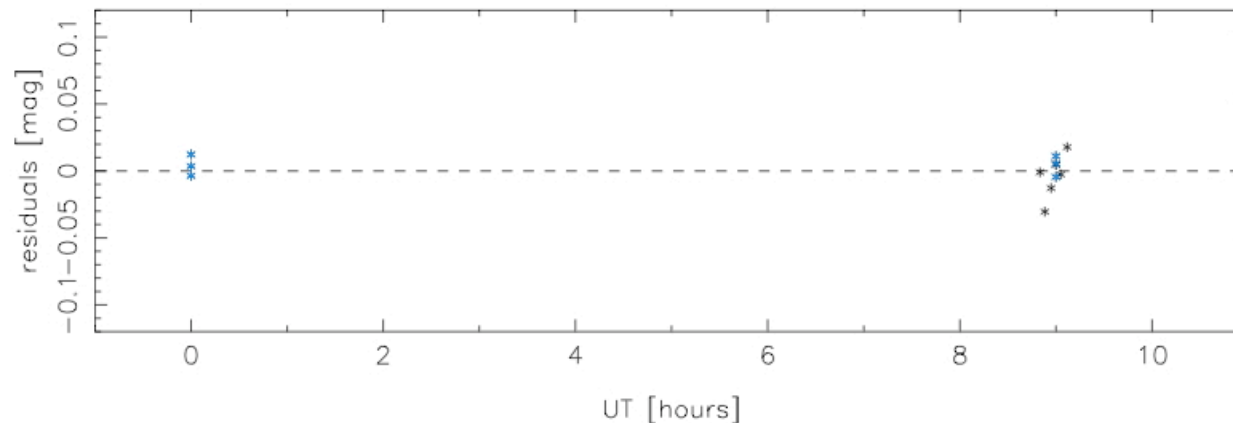
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PreCam Extinction Study Simulations : PreCam (0.02mag Errors) + Stripe 82

Photometric Solution: tile-2012-1-g.par, night 20 (MJD56197)



Supplement
with twilight
observations
in Stripe 82
to get better
 σ_{mean}





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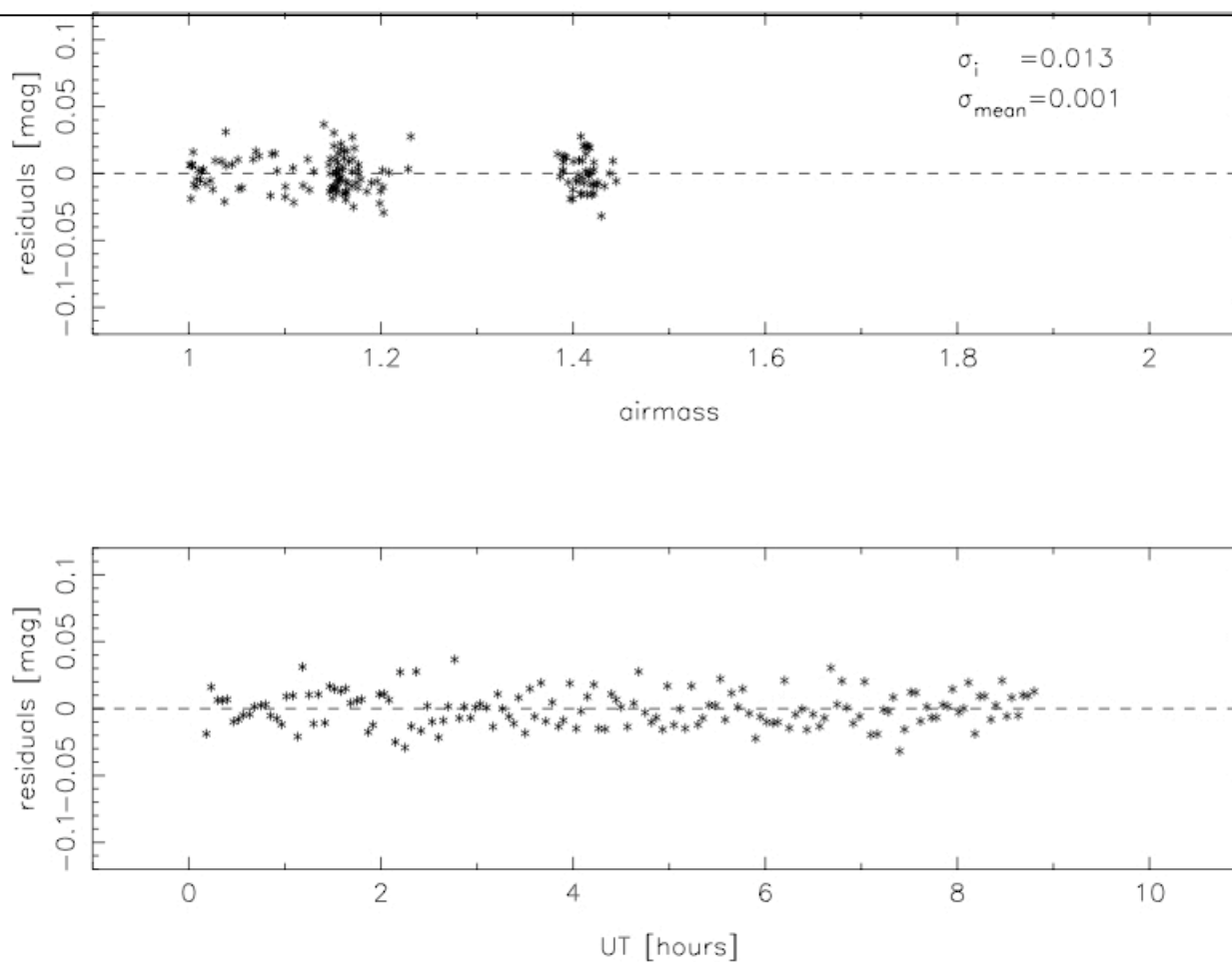
Extra Slides



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PreCam Extinction Study Simulations

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)

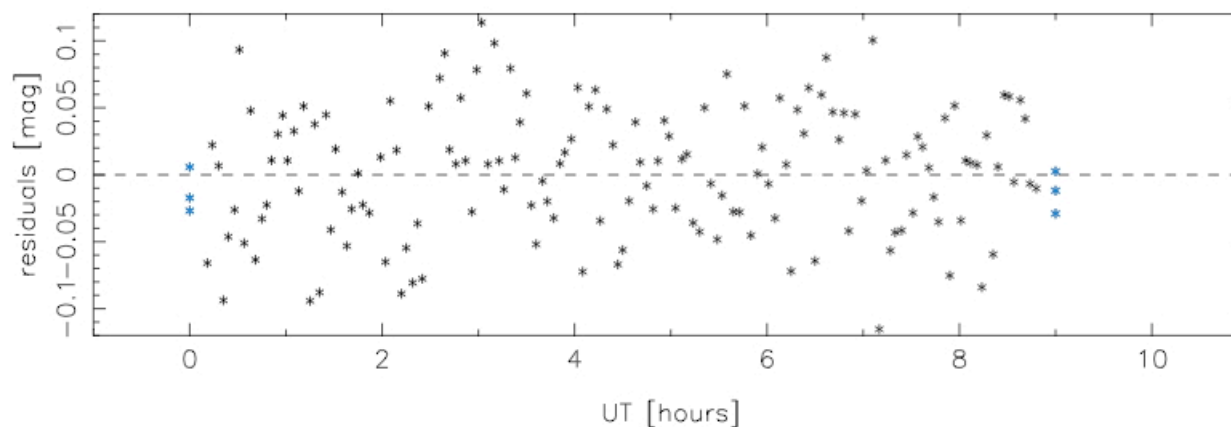
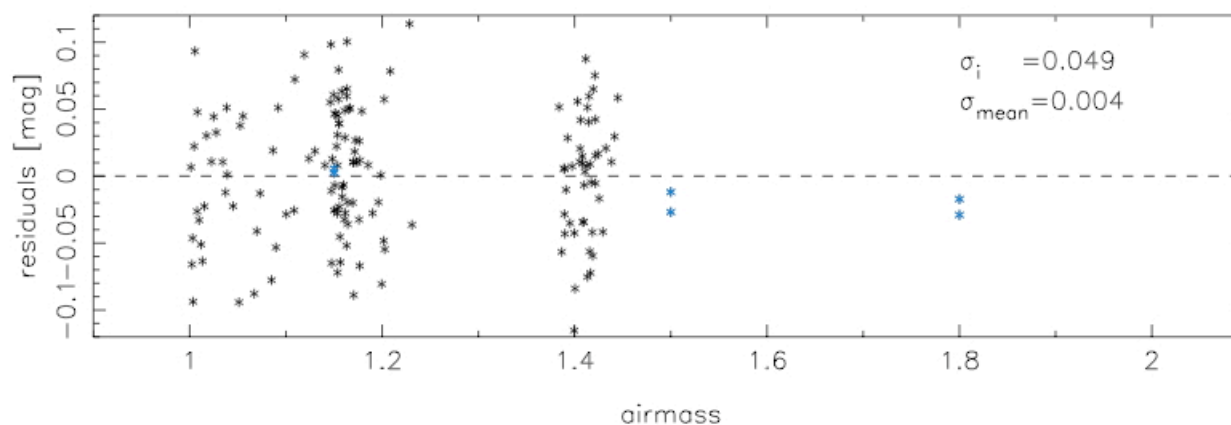




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PreCam Extinction Study Simulations: PreCam (0.05mag Errors) + Stripe 82

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)

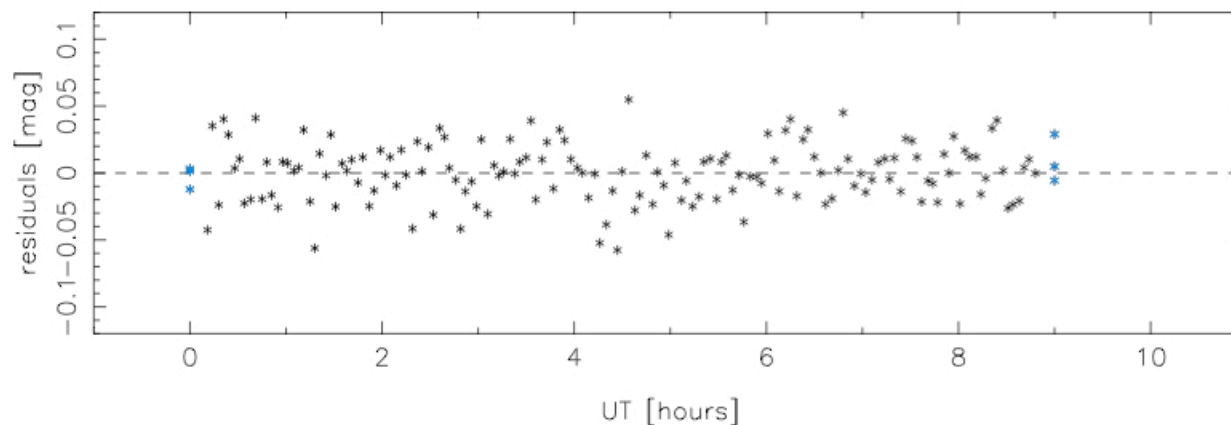
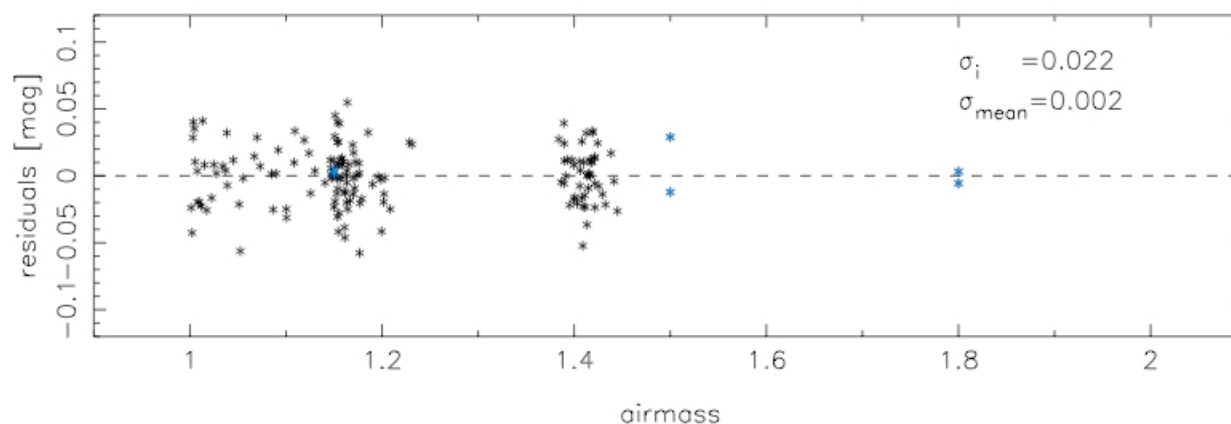




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PreCam Extinction Study Simulations: PreCam (0.02mag Errors) + Stripe 82

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)

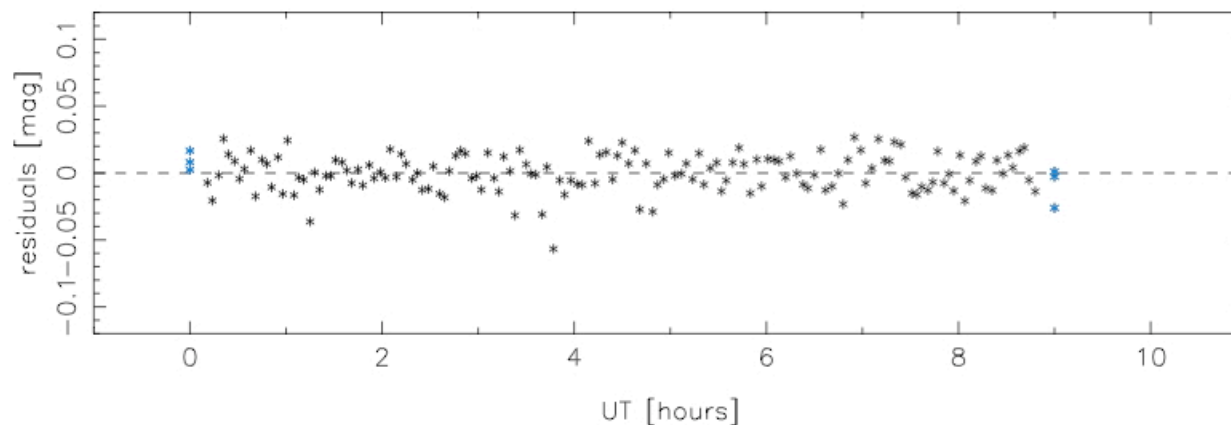
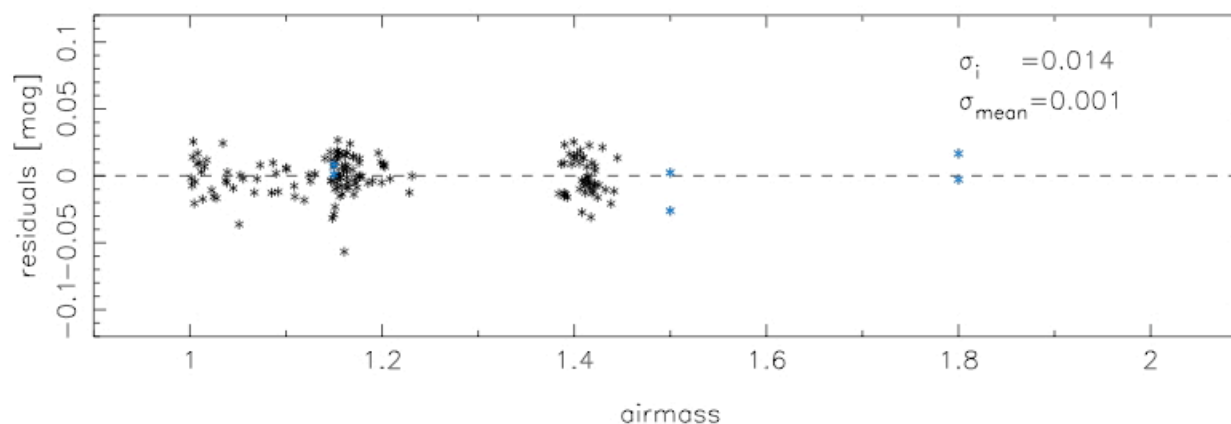




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PreCam Extinction Study Simulations: PreCam (0.01mag Errors) + Stripe 82

Photometric Solution: tile-2012-1-g.par, night 30 (MJD56210)





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PreCam Extinction Study Simulations: Toy Model

- $m_{\text{inst}} - m_{\text{true}} = a + k \cdot X$
- Assume fixed values for a , k , and m_{true}
- Assume the values for m_{true} have Gaussian errors (due to PreCam field-to-field systematics) of
 - 0.05 mag (easy)
 - 0.02 mag (do-able)
 - 0.01 mag (challenging)
- Calculate m_{inst} , assuming zero measurement errors (due to beating down the statistical errors due to the 100's of stars per DECam chip)
- Do above for all airmasses X from a night as tabulated in Jim's simulations.
- Fit for a and k
- Calculate residuals